

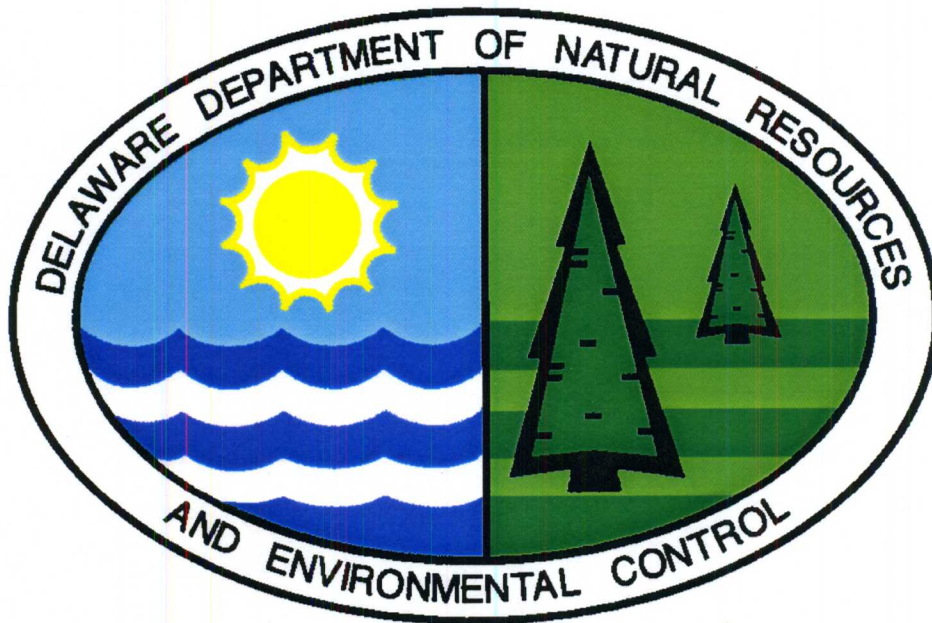
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PROPOSED PLAN OF REMEDIAL ACTION

Syntech Site
835 Dawson Drive
Newark, DE

DNREC Project No. DE 0173



March 2003

Delaware Department of Natural Resources and Environmental Control
Division of Air and Waste Management
Site Investigation & Restoration Branch
391 Lukens Drive
New Castle, Delaware 19720

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1.0 INTRODUCTION

The Synthesis Technologies (Syntech site) is located at 835 Dawson Drive in the Delaware Industrial Park, which is just outside of the City of Newark, New Castle County, Delaware. The site, which occupies a total of approximately 3.5 acres within the Delaware Industrial Park, is bordered to the north by Dawson Drive, to the south by an elevated section of Interstate 95, to the east by DuHadaway Tool and Die Company (DuHadaway), and to the west by Maaco Automobile Painting Company (Maaco) and Murphy Steel, Inc (Murphy).

The site, which is owned by the State of Delaware Economic Development Office (DEDO), is presently inactive and secured by a chain link fence. The former Syntech plant area, which consists of a main building, as well as separate structures for the boiler and pilot plants along with a paved drum storage area, occupies the northern 2.25 acres of the site.

The southern portion of the property is unsecured and consists of an open field overgrown with tall grass and low brush that covers approximately 1.25 acres. This area of the site is currently being leased to Murphy by DEDO, and is used for storage of finished steel products.

The land use surrounding the site is light industrial/commercial with several small industrial parks located nearby.

The purpose of previously completed environmental studies and the recently completed focused feasibility study (FSS) was to: 1) collect additional information from the site to document existing groundwater and soil conditions at the site; 2) delineate and determine the extent of potential contamination, and its possible migration and environmental impacts; and 3) determine the level of risk posed by the contaminants, and based upon this analysis, evaluate remedial alternatives.

This document is the Department of Natural Resources and Environmental Controls (DNREC) proposed plan of remedial action (proposed plan) for the site. It is based on the results of the previous investigations performed at the site. This proposed plan is issued under the provisions of the Hazardous Substance Cleanup Act (HSCA), 7 Del. C., Chapter 91, and the Regulations Governing Hazardous Substance Cleanup (Regulations). It presents the Department's assessment of the potential health and environmental risks posed by the site.

As described in Section 12 of the Regulations, DNREC will provide notice to the public and an opportunity for the public to comment on the proposed plan. At the comment period's conclusion, DNREC will review and consider all of the comments received and then DNREC will issue a final plan of remedial action (final plan). The final plan will designate the selected remedy for the site. All previous investigations of the site, the proposed plan, the comments received from the public, DNREC responses to those comments, and the final plan will constitute the Remedial Decision Record for the site.

Section 2 presents a summary of the site description and history. Section 3 provides a description of the remedial investigation results. Section 4 presents a discussion of the remedial action objectives. Section 5 presents the proposed plan of remedial action. Section 6 discusses public participation requirements.

2.0 SITE DESCRIPTION AND HISTORY

2.1 Site Setting

The site is located within the Delaware Industrial Park just outside of the City of Newark, New Castle County, Delaware (Figure 1). The site is bordered to the north by Dawson Drive, to the south by an elevated section of Interstate 95, to the east by DuHadaway, and to the west by Maaco and Murphy. The site consists of 3.5 acres of land (New Castle County Tax Parcel Number 11-010.00-068) and is partially covered by a building that is currently unoccupied. The surrounding land use is generally comprised of commercial and/or industrial uses.

2.2 Site and Project History

Prior to 1940, the site and its surrounding area was either used for agricultural purposes, or left as open, vegetated land. During World War II, a series of concrete bunkers were constructed throughout the area to store munitions.

Between 1981 and 1987, Helix Associates (Helix) operated a specialty chemicals manufacturing and processing facility on the site which reportedly recovered iodine from waste sulfuric acid solutions. In 1986, an explosion in a reactor vessel destroyed a portion of the manufacturing building and eventually led to closure of the Helix facility. As part of the closure requirements, Helix conducted an investigation of the site in August 1989. Volatile organic compounds (VOCs) were detected in groundwater at the site in milligram per liter (mg/l) concentrations with the highest levels of VOCs occurring in the groundwater east/southeast of the building where the vessel had exploded.

Between 1987 and 1989, there was no reported activity or change in site ownership.

Between 1989 and 1991, Syntech operated the facility manufacturing specialty batch diazo compounds, including dyes for cloth, color photography, and biological tissue staining. In 1990, a reactor leaked vapor containing heptanes and nitric acid into the outside atmosphere. Subsequent inspections by the DNREC Emergency Response Branch (ERB) identified poor stock and waste management practices and visually leaking drums. Syntech began to classify, overpack and dispose of the chemicals off-site at a RCRA facility under an Imminent Hazard Order from DNREC. The company ceased operations and dissolved its corporation prior to completing the cleanup, and DNREC contracted with a private consultant to complete the work.

Investigations were conducted at the site between 1994 and 2001 by DNREC. All previous onsite groundwater sample locations are shown on Figure 2.

In 1994, DNREC performed a facility evaluation (FE) of the site. Additional monitoring wells were installed at the site and additional on-site soil and groundwater samples were collected. Two domestic wells located south of the site, along with six water supply wells from the City of Newark's South Well Field (SWF), were also sampled. The location of the wells in the SWF are shown on Figure 1. The analytical results from the samples from the domestic wells and Newark's water supply wells did not detect site-related organic contamination in the groundwater. However, a groundwater sample from MW-12 located near the plant detected chlorobenzene at 2% of its solubility limit in water suggesting that dense non-aqueous phase

liquid (DNAPL) might be present in the vicinity of the well. Although aniline and o-toluidine were present at concentrations comparable to chlorobenzene, the concentrations were not a significant percentage of their solubility in water.

In the fall of 1995, WIK Associates, Inc. conducted a FE of the property at 801 Dawson Drive to the east of Syntech, which was formerly owned by Process Industries and is now owned by DuHadaway Tool and Dye Company (DuHadaway). Two monitoring wells were installed to evaluate groundwater quality on the property. Contaminants associated with the Syntech site were present in the sample from a monitoring well MW01-W001 located on the property boundary with Syntech. Also of note was that 1,2-dichloroethane was detected in that sample but was not found in any of the Syntech on-site wells, which suggests that there may be additional sources of the groundwater contamination in the area.

Between 1998 and 1999, DNREC's contractor, Camp Dresser and McKee (CDM), completed a remedial investigation (RI), a human risk assessment (HRA), and feasibility study (FS) of the Syntech site. The RI focused on the groundwater pathway at the site. Additional monitoring wells were installed in the surficial water-bearing sands of the Columbia Formation and also in the uppermost confined sand aquifer of the Potomac Formation, which correlates with the screened section of the City of Newark water supply well, PW-16, located approximately 1,200 feet downgradient of the former process area. Well PW-16, which is screened in the Potomac Aquifer, was formerly the most productive well in the SWF with an allocation of 475 gallons per minute (gpm). The well was placed in service in July 1977 and pumped nearly continuously until July 1990. The RI concluded that contaminant migration appeared to be limited to a distance of approximately 200 to 250 feet in the hydraulically downgradient direction, and the contaminants did not appear to have migrated vertically downward into the Potomac Formation.

In the fall of 2000, DNREC's contractor, Tetra Tech, Inc. (Tetra Tech), conducted a direct push sampling event in the former plant area. Carbon tetrachloride (CT) was detected in groundwater just outside the main plant at a concentration of 47 mg/l, which is approximately 1% of its solubility in water, suggesting that CT might be present in the groundwater as a DNAPL and may provide a continuous source of groundwater contamination at the site.

In July 2001, Tetra Tech performed additional groundwater sampling activities at the Syntech site in order to obtain current data on groundwater quality. The concentrations of chlorobenzene reported from groundwater samples taken during this sampling event ranged from 3.5 mg/l in monitoring well MW-12 to 5 mg/l in monitoring well MW-13, indicating that chlorobenzene might also be present in the groundwater as a DNAPL.

Between February 19 and 21, 2002, Tetra Tech's subcontractor, Columbia Technologies, completed a Membrane Interface Probing (MIP) program at Syntech which identified a "hot spot" between 10 to 12 feet below ground surface located outside of the door at the rear of the main plant near the boiler room. Tetra Tech used this additional data to revise the FS, originally prepared by CDM in August 1999, and submitted a focused feasibility study update (FFSU) to DNREC on April 15, 2002.

In August 2002, the City of Newark publicly announced that it planned to return the wells in the SWF to service, including PW-16. It is expected that this will occur in spring of 2003, when the water treatment plant is completed.

3.0 INVESTIGATION RESULTS

DNREC performed a FE of the Syntech facility in 1994, which indicated elevated concentrations of contaminants were detected in groundwater both on and off-site. DNREC's FE report recommended that additional environmental investigation be conducted, in the form of an RI, to ascertain the lateral and vertical extent of contamination at the site.

Subsequently, DNREC had a contractor further characterize the site in 1999. The resultant RI and FFS reports concluded that both subsurface soil and groundwater contamination existed in the immediate vicinity of the main production facility. Details of the site, the nature and extent of contamination, risk assessment, and Applicable or Relevant and Appropriate Requirements (ARARs) can be found in the FE report, as well as the RI, HRA and FFS reports. The following are the references:

1. Facility Evaluation Report of Syntech Facility, 1994, State of Delaware, DNREC
2. Remedial Investigation Report, August 1999, CDM
3. Human Health Risk Assessment, August 1999, CDM
4. Focused Feasibility Study Report, August 1999, CDM

Between May 2000 and March 2001, several attempts were made by DNREC's contractor, Tetra Tech, to delineate and characterize the "source area" alluded to in the RI Report through the implementation of four direct push (DP) investigations of the main production area. Figures 3, 4, 5 and 6 depict the results of the sampling and analysis performed during each of the DP events.

Tetra Tech also conducted groundwater sampling events in October 2000, March and July 2001 to determine the aerial extent of the contaminant plume. Figure 6 depicts the concentrations of contaminants detected in the monitoring wells in July 2001.

A Membrane Interface Probe (MIP) investigation was also performed by Tetra Tech in February 2002 to further delineate the potential source area. Figure 7 illustrates the results of the MIP investigation.

Figure 8 illustrates the results of these latest groundwater investigations as well as the location of the potential source area and the extent of the groundwater plume.

The results of the investigations are described briefly below:

- Source Area: Since no contaminants of concern were detected in the soil samples collected throughout the additional areas of investigation, the source of the groundwater contamination is likely a localized point source probably related to random drum leakage or spills. Although the specific source area has not been identified, a potential source area characterized by the highest groundwater contamination levels has been identified in the area bordered by the pilot plant, boiler room and main plant area (see Figure 2). For purposes of the FS, the potential source area is defined as the impacted groundwater and soil in this area and is approximately 60 feet by 120 feet in size (Figure 8). Chlorinated methanes (methylene chloride, chloroform, and carbon tetrachloride), 1, 2-

dichloroethane, and chlorobenzene have been detected in the groundwater within this potential source area.

- Groundwater Plume: Based on the groundwater sampling results, the groundwater plume appears to extend from the main building in a southeastward direction onto the adjacent property which is owned by DuHadaway. The groundwater plume, including the source area, is about 275 feet by 200 feet in dimension (Figure 8) and appears to have remained stable since 1997. Maximum contaminant concentrations within the groundwater plume area have been consistently detected at monitoring wells MW-13, MW-12, MW-7, and MW-1 in several sampling events. The contaminants detected in these wells are benzene, chlorobenzene, ethylbenzene, phenol, aniline, o-toluidine, and 1, 4-dichloro benzene.

Groundwater Monitoring Results Over Time

Four groundwater sampling events were conducted during the FFS. The sample locations are shown on Figure 2. Tables 1 through 4 contain a summary of the groundwater analytical data from monitoring wells sampled in November 1997 and July 2001 including VOCs, semivolatile organic compounds (SVOCs), the groundwater uniform risk-based standards (URS) values for the analytes, and highlights the concentrations of the analytes that exceeded their URS values. Groundwater analytical data is also described briefly in the following paragraphs:

- VOCs (Tables 1 and 3): Acetone, benzene, chlorobenzene, chloroform and 1,2-dichloroethane were the only VOCs that were detected in groundwater samples above their respective groundwater URS values. For example, chlorobenzene, detected at a concentration of 3,700 micrograms per liter ($\mu\text{g/l}$) in monitoring well MW-12 and at 5,000 $\mu\text{g/l}$ on July 2001 in MW-13, exceeded the groundwater URS value of 100 $\mu\text{g/l}$.
- SVOCs (Table 2 and 4): Groundwater samples from monitor wells MW-12 and MW-13 contained several SVOCs, such as naphthalene and bis(2-ethylhexyl)phthalate, that were reported at concentrations estimated to be above the instrument detection limits but less than the method detection limit. None of these SVOCs exceeded their respective groundwater URS values. However, aniline, 4-chloraniline and 1, 4-dichlorobenzene exceeded their respective groundwater URS values during the July 2001 sampling event.
- Based on groundwater elevations measured in monitoring wells screened in both the Columbia and Potomac aquifers, the groundwater flow direction is toward the southeast.

Risk Assessment

The primary objective of the initial assessment of relative risk is to assist in identifying potential threats to human health and/or the environment. The assessment is essentially a process where analytical results from a HSCA-certified laboratory are compared to Delaware HSCA URS. In addition to this comparison, a cumulative risk assessment was conducted using the groundwater analytical results.

The Syntech site is currently used for commercial purposes and is intended for commercial use in the future.

The following summarizes the regulatory exceedances detected during the RI and identifies the potential contaminants of concern (COCs):

- Based on the summary of regulatory exceedances, 1,2 dichloroethane, benzene, chlorobenzene, bis(2-ethylhexyl)phthalate, 1,1 dichloroethene, aniline, o-toluidine, nitrobenzene, and 4-chloroaniline were selected as COCs for the risk assessment.
- The risk assessment indicates that the cumulative carcinogenic risk associated with site groundwater for a future residential scenario is 1.3×10^{-3} with o-toluidine being the COC that contributes the most to the carcinogenic risk. The total risk for the future worker scenario was calculated to be 3×10^{-4} . The risk assessment also indicated that the cumulative non-cancer Hazard Index associated with site groundwater is 14 for future residents and 2.1 for future workers. The chemicals which contributed the most to the noncarcinogenic risks are aniline, chlorobenzene, and nitrobenzene.

The site is presently inactive although properties surrounding the site are active. Since the site is located within the Delaware Industrial Park, future use of the site will be restricted to industrial or commercial use. It is likely that, in the future, the existing structures on the site will either be replaced by new structures or be significantly modified to accommodate new facilities. Therefore, the remedial action must be protective of future construction workers and future site residents/employees.

4.0 REMEDIAL ACTION OBJECTIVES

According to Section 8.4 (1) of the Regulations, site-specific remedial action objectives (RAOs) must be established for all plans of remedial action. The Regulations provide that DNREC set objectives for land use, resource use and cleanup levels that are protective of human health and the environment.

Qualitative objectives describe in general terms what the ultimate result of the remedial action, if necessary, should be. The following qualitative objectives are determined to be appropriate for the site:

- Prevent exposure to impacted media by future site users;
- Prevent further migration of contaminated groundwater;
- Minimize potential exposure to site COCs for construction workers at the site; and
- Continue the use of public water for all purposes to the surrounding community.

These objectives are consistent with the current use of the site as a commercial use in an urban setting, New Castle County zoning policies, state regulations governing water supply and worker health and safety.

Based on the qualitative objectives, the quantitative objectives are:

1. Prevent human exposure to contaminated groundwater that would result in a carcinogenic risk exceeding 1×10^{-5} or a hazard index of 1.0.

2. Prevent ingestion of groundwater that exceeds the DNREC groundwater URS values.
3. Prevent the discharge of contaminated groundwater that exceeds the Delaware Surface Water Quality Standards.

Four remedial options were evaluated by Tetra Tech in the revised FFS for their ability to accomplish the RAOs in both the source and plume areas. The remedial actions considered for the source area are:

Alternative 1: No Action - The no-action alternative provides a baseline for comparing other alternatives. Under the no-action alternative, no additional remedial measures would be implemented at the site to address the site contaminants.

Alternative 2: Air Sparging-Vapor Extraction - The predominant contaminants of concern in the source area are chlorinated methanes, which are generally amenable to air sparging and vapor extraction. This alternative involves the installation of four rows of sparge points (SP) and three soil vapor extraction (SVE) lines – one between each of the SP rows. Each of the rows will have eight SPs that are 15 feet apart. Air will be sparged into the aquifer stripping the chlorinated hydrocarbons into the vapor phase. The vapors will be collected by the SVE lines and treated in a CATOX unit prior to atmospheric discharge. This alternative includes the installation of four monitoring wells within the source zone and quarterly sampling for three years.

Alternative 3: Fenton's Reagent Injection - This alternative uses Fenton's reagent for the degradation of organics. In this alternative hydrogen peroxide and an aqueous solution of ferrous sulfate will be injected into the soil and groundwater to oxidize the groundwater contaminants. However, Fenton's reagent is ineffective in oxidizing chlorinated methanes such as methylene chloride, chloroform, and carbon tetrachloride, since these compounds are particularly recalcitrant. Chlorinated methanes are known to be oxidized only by ultraviolet oxidation, i.e., in the presence of hydrogen peroxide and ultraviolet light. This option is not feasible in the source area.

Alternative 4: Hydrogen Release Compound Injection/Application - This alternative uses a hydrogen release compound (HRC) to passively treat chlorinated hydrocarbons at the site through enhanced biodegradation. This alternative involves anaerobically dechlorinating chlorinated methanes to innocuous byproducts. HRC is a proprietary, polylactate ester formulated for the slow release of lactic acid upon hydration. Indigenous anaerobic microbes metabolize the lactic acid generated by HRC and produce hydrogen; the resulting hydrogen is then used by reductive dehalogenators, which dechlorinate the chlorinated methanes. This alternative involves injecting/applying HRC to the saturated thickness of about 16 feet by a Geoprobe® and grout injecting machine. For this alternative 32 Geoprobe® locations are assumed at 15 feet intervals over the 60 ft. by 120 ft. source area on Syntech (Figure 8). The HRC will be injected/applied at a rate of 10 pounds per foot resulting in a total HRC application of 5,120 pounds of HRC. Typically anaerobic degradation of contaminants is a slow process, and remediation could take anywhere from six months to a year. This alternative includes the installation of four monitoring wells within the source zone and quarterly sampling for three years. After the HRC has been completely utilized, ORC may be injected to remediate contaminants that can be degraded aerobically. ORC injection is discussed in the plume area-Alternative 4 below.

The remedial actions under consideration for the plume area are:

Alternative 1: No Action - The description for this alternative is similar to the description of Alternative 1 for the source area.

Alternative 2: Monitored Natural Attenuation - This alternative includes periodic monitoring of groundwater concentrations at the periphery of the site and immediately downgradient of the site. A component of the monitoring program would involve the development of a program to verify the extent that the attenuation processes are occurring and are effective. This requires a complimentary source area reduction remedy. Contaminant concentration in monitoring wells MW-22, and MW-P2, located on the Duhadaway property, and MW-17, MW-13, MW-12, MW-7, and MW-1 located on Syntech should be monitored as part of the natural attenuation program, initially for a period of 10 years (quarterly for the first three years, and semi-annually thereafter).

Alternative 3: Fenton's Reagent Injection - This alternative uses Fenton's reagent for the degradation of organics. In this innovative technology, hydrogen peroxide and an aqueous solution of ferrous sulfate is injected into the soil and groundwater to oxidize the groundwater contaminants. The hydroxide radical is a powerful oxidizing agent and oxidizes hydrocarbons to carbon dioxide and water. The reagents will be injected through injectors that are installed to encompass the vertical and horizontal distribution of the contaminant plume. For the groundwater plume approximately 64 injectors will be required with a radius of influence of about 15 feet, and a contaminated saturated thickness of about 16 feet. This alternative also includes quarterly sampling of monitoring wells MW-22, MW-P2, MW-17, MW-13, MW-12, MW-7, and MW-1 for a three-year period to assess the effectiveness of the remedial measure.

Alternative 4: Oxygen Release Compound Injection/Application - This alternative uses a oxygen release compound (ORC) to passively treat the hydrocarbons in the groundwater within the plume area (Figure 8) beneath Syntech and DuHadaway. ORC is a passive in-situ bioremediation approach, which uses a patented formulation of magnesium peroxide that slowly releases oxygen when hydrated. This alternative involves enhancing the natural attenuation of contaminants by aerobically biodegrading the contaminants to innocuous byproducts. This alternative involves injecting/applying ORC in twelve rows that are 25 feet apart; each row containing 20 points that are 10 feet apart. The ORC has to be applied to the contaminated saturated thickness of 16 feet at a rate of 6 pounds per foot with a Geoprobe® grout injecting machine; this translates to 23,040 pounds of ORC. This alternative also includes quarterly sampling of monitoring wells MW-22, MW-P2, MW-17, MW-13, MW-12, MW-7, and MW-1 for a three-year period to assess the effectiveness of the remedial measure.

Evaluation of Alternatives

Each alternative is assessed against the evaluation criteria as developed by the U.S. Environmental Protection Agency (USEPA) and DNREC; the comparative analysis of alternatives for the source area is presented in Table 5, and for the groundwater plume, in Table 6.

Based on the individual analysis of effectiveness, implementability, and cost, the following observations are made about the potential remedial alternatives:

Alternative 1, the no-action remedy, does not remediate either the source or the groundwater plume and does not contain the plume; therefore, it is not protective of the human health and the environment.

Alternative 2 (air sparging-vapor extraction) and Alternative 4 (HRC application/injection) for the source area are protective of human health and the environment and comply with local, state, and federal regulations.

In general, all alternatives other than Alternative 1 (no action) for the plume are protective of human health and the environment and comply with local, state, and federal regulations.

Alternative 4 for the source area and Alternative 2 for the plume will be effective for the site.

Due to the presence of recalcitrant chlorinated methanes in the source area, it is likely that, Alternative 3 the injection of Fenton's reagent, will not be effective, but anaerobic dechlorination with HRC Alternative 4, will be effective.

In the groundwater plume area, Alternative 4, the injection/application of ORC, will be effective in aiding natural attenuation processes.

5.0 PROPOSED PLAN OF REMEDIAL ACTION

Based on DNREC-SIRB's evaluation of all the available site information and the above remedial action objectives, the recommended remedial actions for the site consist of the following activities:

1. Application/injection of hydrogen release compound (HRC) in the potential source area between the main building, the pilot and boiler plants and the paved drum storage area on the Syntech site. The HRC application in the source area will be followed by oxygen release compound (ORC) application in the groundwater plume area which extends onto the adjacent property owned by DuHadaway Tool and Die Company. The HRC and ORC will be added to the groundwater as needed over a three-year period. A Groundwater Quality Monitoring Program (GQMP) will be developed for the plume by DNREC. As part of the GQMP, the effectiveness of the remedial action in the source and plume areas will be monitored. Quarterly groundwater monitoring will be performed for a three-year period. Following the three-year monitoring period, the site will be re-evaluated for effectiveness and another remedy may be proposed by DNREC.
2. The State will place a deed restriction on the property: a) limiting the site to non-residential uses; prohibiting any demolition of or land-disturbing activities in the footprint of the main building, the pilot and boiler plants and the paved drum storage area on the property without the prior written approval of DNREC; and c) prohibiting the installation of any water well on, or use of groundwater at, the site without the prior written approval of DNREC.

3. DNREC will establish a Groundwater Management Zone (GMZ) for the site and the portion of the contaminant plume which also extends onto the adjacent DuHadaway property.

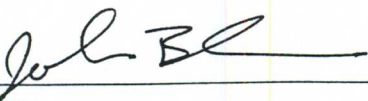
6.0 PUBLIC PARTICIPATION

The Department actively solicits public comments or suggestions on the proposed plan of remedial action and welcomes opportunities to answer questions. Please direct written or verbal comments to:

Attention: Robert C. Asreen, Jr.
DNREC Site Investigation and Restoration Branch
391 Lukens Drive
New Castle, Delaware 19720
302-395-2600

The comment period begins April 7, 2003, and ends at the close of business (4:30 p.m.) May 1, 2003. A public hearing will be held on the Proposed Plan at the Newark High School at 750 East Delaware Ave., Newark, Delaware 19711 on May 1, 2003 at 6 P.M.

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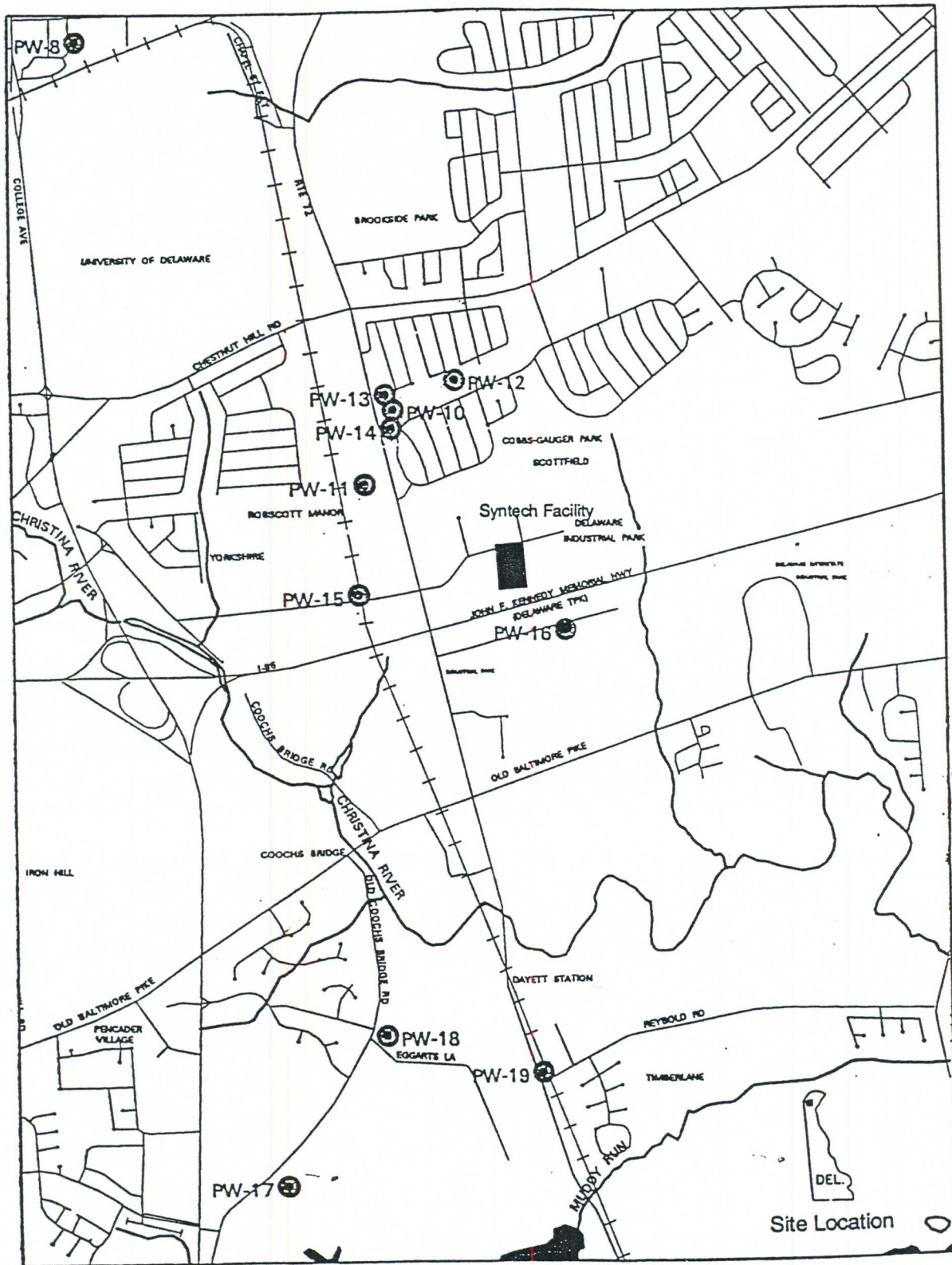


John Blevins
Director, Division of Air and Waste Management

3/31/03

Date of Review of Proposed Plan

Figure 1: Site Location Map Illustrating Newark South Wellfield Public Wells (PW)



Scale 1=24000

Base map created by: Water Resource Agency for New Castle County

Figure 2: Direct Push Soil Sampling Locations & Results May, 2000

SHEA WAY

DAWSON DRIVE

Process Industries Inc.

CCNC. PAD

bis 2 = 58

bis 2 = 190J

GP-4

GP-5

GP-8

GP-12

GP-13

GP-3

Office

Laboratory Area

GP-7

GP-11

Pilot Plant

GP-14

GP-15

SHED

GP-2

GARAGE DOOR

Main Plant Area

GP-8

GP-9

CCNC. PAD

GP-10

ELEC. BOX

GDP-18

Boiler Room

GP-16

GP-21

GP-1

CCNC. PAD

GP-17

GP-19

bis 2 = 120J

GP-20

CCNC. PAD

GP-24

HOLDING TANKS

SUMP

bis 2 = 39J

HOLDING TANK

FUEL OIL TANK

FORMER DRUM STORAGE AREA

STORAGE TRAILERS

AUXILIARY EQUIP STORAGE AREA

GP-22

CCNC. PAD

Drum Storage Area

GP-23

MAACO Automobile Painting

KEY:

bis (2-ethylhexyl)phthalate = bis 2

LEGEND:

- Site Boundary Line
- - - - - Approximate Location of Chain Link Fence
- GP-1 ● Direct Push Geoprobe Soil Sample Location



TETRA TECH, INC.

Figure 1

Direct Push Soil Sampling Locations and Results - ug/Kg
May, 2000
Syntech Site
Newark, Delaware

NOT TO SCALE

Figure 3: Direct Push Groundwater Sampling Locations & Results June, 2000

SHEA
WAY

DAWSON DRIVE

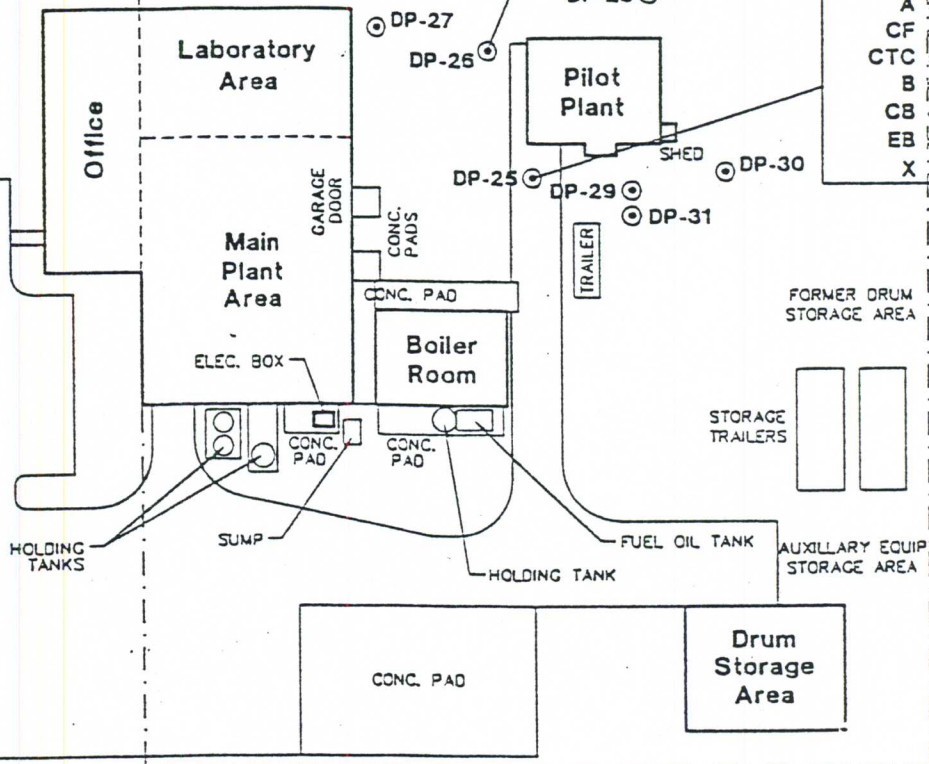
Process
Industries
Inc.

CONC. PAD

CF = 32
CTC = 25

CF = 5J
1,2 DCA = 8J
B = 11
CB = 1,600
EB = 28

A = 52
CF = 15
CTC = 22
B = 24
CB = 750
EB = 19
X = 29



MAACO
Automobile Painting

KEY:

Aniline = A
Benzene = B
Chlorobenzene = CB
Chloroform - CHCL₃ = CF
Carbontetrachloride - CCL₄ = CTC
1,2-Dichloroethane = 1,2 DCA
Ethylbenzene = EB
Xylene = X

LEGEND:

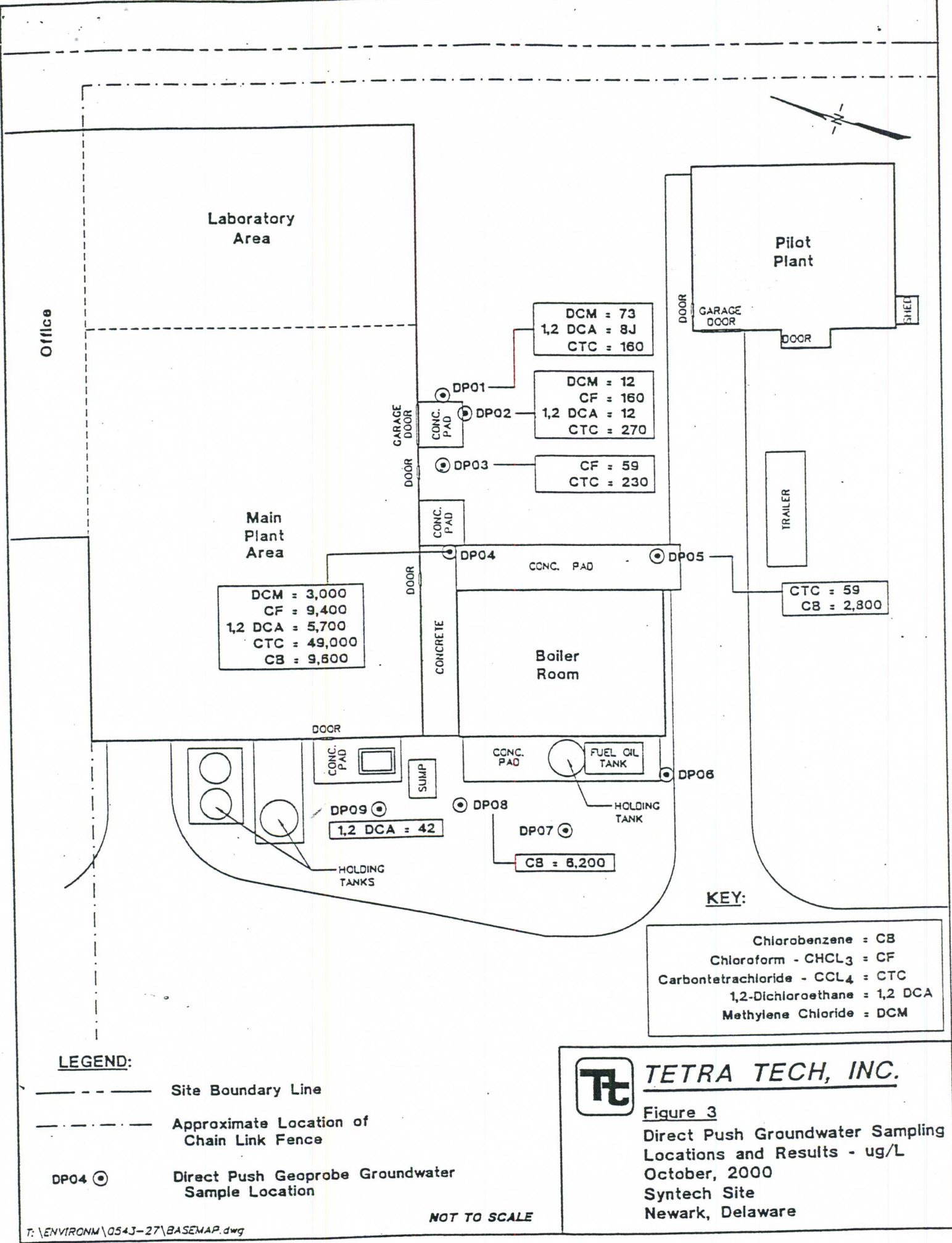
- Site Boundary Line
- Approximate Location of Chain Link Fence
- DP-26 ● Direct Push Geoprobe Groundwater Sample Location



TETRA TECH, INC.

Figure 2
Direct Push Groundwater Sampling
Locations and Results - ug/L
June, 2000
Syntech Site
Newark, Delaware

Figure 4: Direct Push Groundwater Sampling Locations & Results October, 2000



TETRA TECH, INC.

Figure 3
Direct Push Groundwater Sampling
Locations and Results - ug/L
October, 2000
Syntech Site
Newark, Delaware

Figure 5: Direct Push Groundwater Sampling Locations & Results March, 2001

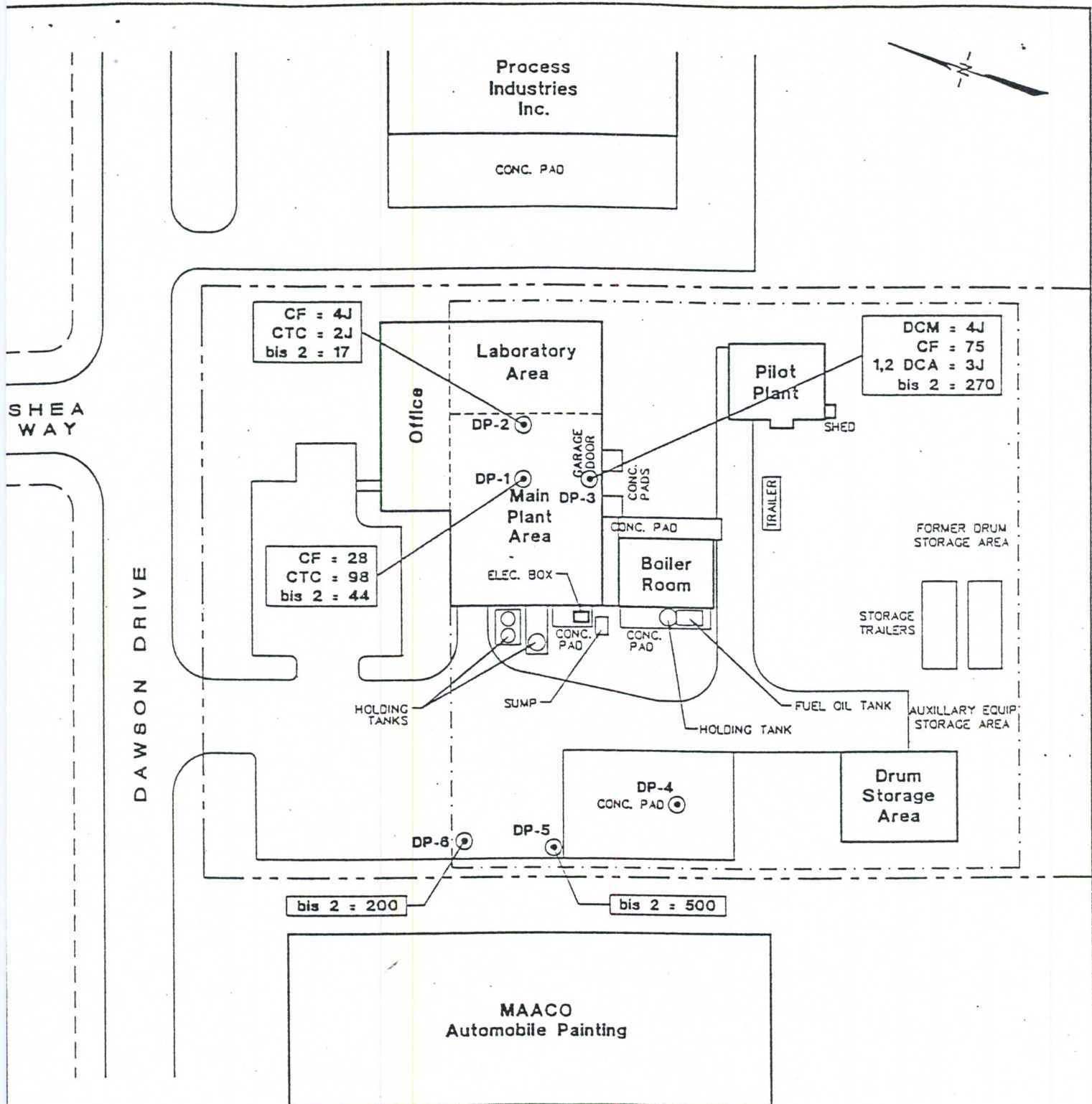
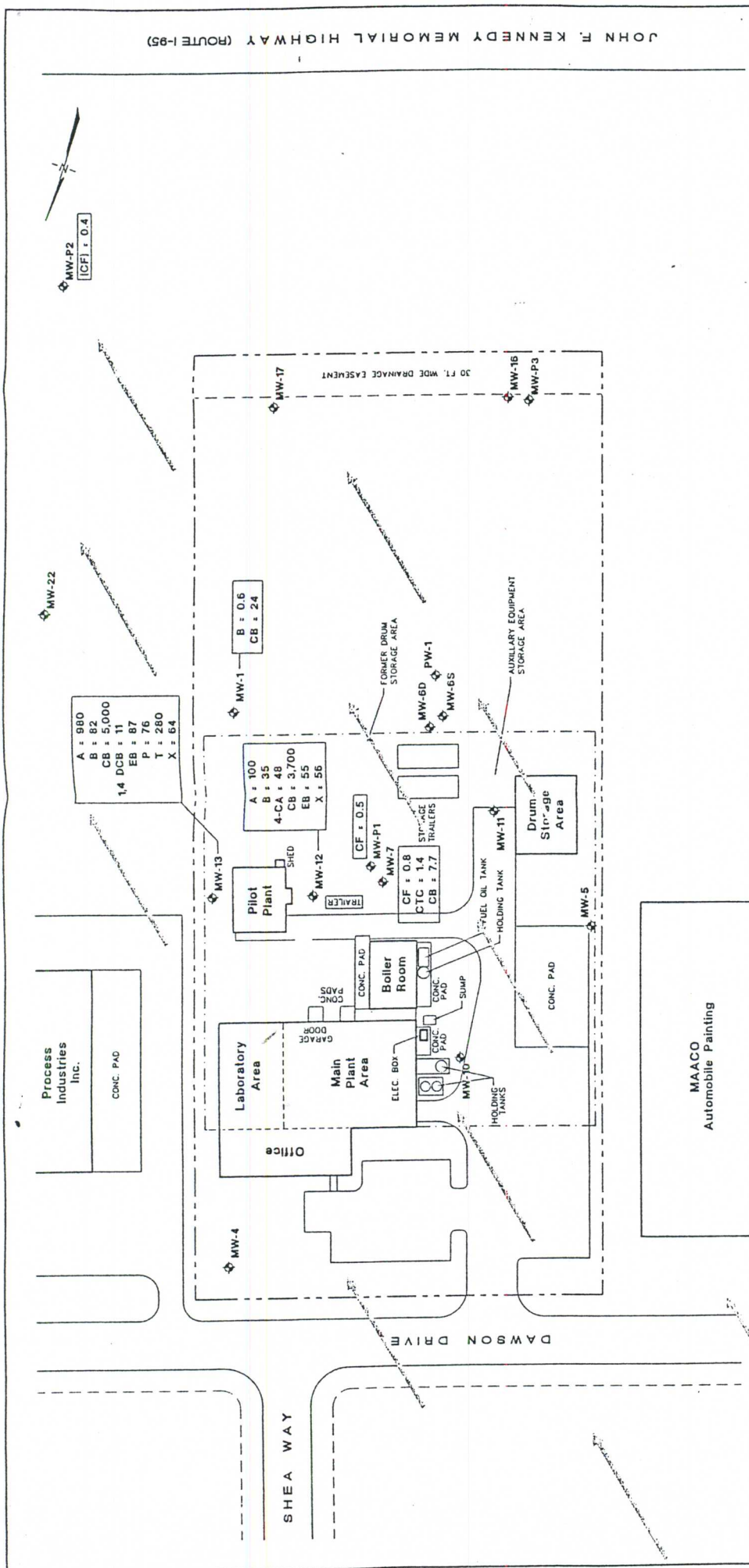


Figure 6: Groundwater Sampling Results for Monitoring Wells July, 2001



KEY:

Aniline	: A
Benzene	: B
4-Chloroaniline	: 4-CA
Chlorobenzene	: CB
Chloroform - CHCl ₃	: CF
Carbon tetrachloride - CCl ₄	: CTC
1,4-Dichlorobenzene	: 1,4 DCB
Ethylbenzene	: EB
Phenol	: P
Toluene	: T
Xylene	: X

LEGEND:

- Site Boundary Line
- Approximate Location of Chain Link Fence
- Existing Monitoring Wells
- Approximate Ground Water Flow Direction

TETRA TECH, INC.

Figure 5
Groundwater Sampling Results
(Monitoring Wells) - ug/L
July, 2001
Syntech Site
Newark, Delaware

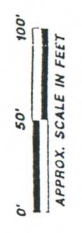
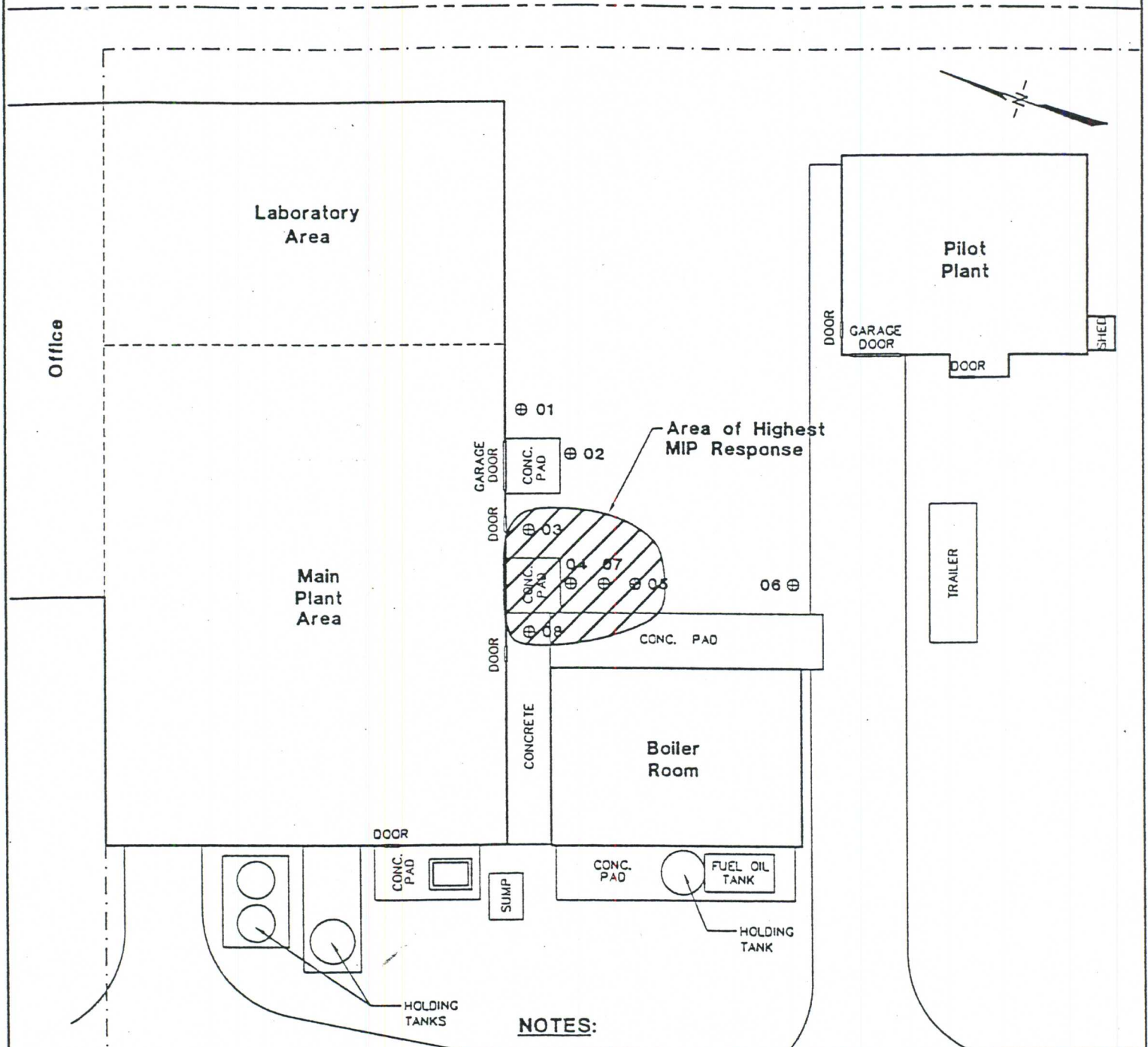


Figure 7: Membrane Interface Probe Investigation Results February, 2002



NOTES:

1. Photo-ionization Detector [PID] = Petroleum Hydrocarbons.
2. Flame-ionization Detector [FID] = CH₄
3. Electron Capture Detector [ECD] = Chlorinated Solvents.
4. PID & FID detections were obtained @ location 06.
5. ECD detections were obtained @ locations 03, 04, 05, 07 and 08.
6. Max. ECD detections were obtained @ 04, 07 and 08 @ a depth of 13 feet.

LEGEND:

- Site Boundary Line
- - - - - Approximate Location of Chain Link Fence
- 02 ⊕ Membrane Interface Probe [MIP] Investigation Location



TETRA TECH, INC.

Figure 6

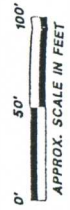
**Membrane Interface Probe [MIP]
Investigation Results -
February, 2002
Syntech Site
Newark, Delaware**

Figure 8: Potential Source Area and Groundwater Plume Delineation



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**Source and Plume Delineation
Syntech Site
Newark, Delaware**



Site Boundary Line
Approximate Location of Chain Link Fence
Existing Monitoring Wells
Potential Source Area
Groundwater Plume Area

Table 1: Summary of November 1997 Groundwater Analytical Data – VOCs

TABLE 1
DATA SUMMARY FORM: VOLATILES
GROUNDWATER 11/97
ug/L

Sample Number	MW1	MW3	MW5	MW7	MW12	MW13	MW15	HSCA URS*
Analyte								Dec-99
Acetone			4 JB					61
Benzene					18	44		5/0.4 c
Carbon disulfide								100
Carbon tetrachloride								5/2 c
Chlorobenzene	9 J	9 J		51	1,800 E / 7,600 D ⁵⁰	4,600 E / 7,600 D ⁴⁵		100/11
Chloroform								
1,2-Dichloroethane		130				5 J	8 J	100/0.1 c
1,2-Dichloroethene								5/0.1 c
Ethylbenzene						95		6
Methylene chloride								700 c
Tetrachloroethene							1 J	5/4 c
Toluene					4 J	19		5/1 c
1,1,1-Trichloroethane								1,000/750
Xylene (total)					120	140	4	200
								10,000/1,200

Bold = Analyte exceeds the URS.

* = HSCA Uniform Risk Based Remediation Standards for groundwater

B = Analyte present in blank.

D = Reported value is result of analysis performed at dilution factor.

E = Reported value exceeded the calibration range of instrument.

J = Analyte present. Reported value is an estimate.

c = carcinogenic

NL = Not Listed

TABLE 1
DATA SUMMARY FORM: VOLATILES
GROUNDWATER 11/97
ug/L

Sample Number Analyte	MW16	MW17	MW18	MWP1	MWP3	HSCA URS*
Acetone				8 J		61
Benzene						5/0.4 c
bis(2-chloroethyl)ether						0.01 c
Carbon disulfide					1 J	100
Carbon tetrachloride						5/2 c
Chlorobenzene						100/11
Chloroform						100/0.1 c
1,2-Dichloroethane	19	9 J	3,200 D ²⁵	1 J		5/0.1 c
1,2-Dichloroethene	3 J					6
Ethylbenzene						700 c
Methylene chloride			59 JD			5/4 c
Tetrachloroethene						5/1 c
Toluene						1,000/750
1,1,1-Trichloroethane	7 J	2 J				200
Xylene (total)						10,000/1,200

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* = HSCA Uniform Risk Based Remediation Standards for groundwater

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E = Reported value exceeded the calibration range of instrument.

J = Analyte present. Reported value is an estimate.

c = carcinogenic

NL = Not Listed

Table 2: Summary of November 1997 Groundwater Analytical Data – SVOCs

TABLE 2
DATA SUMMARY FORM: SEMIVOLATILES
GROUNDWATER 11/97
ug/L

Sample Number Analyte	MW1	MW2	MW3	MW4	MW5	MW6S	MW6D	HSCA URS* Dec-99
Aniline								12 c
bis(2-ethylhexyl)phthalate	9 JB	4 JB	6 JB	10 B	210 BE / 170 BD	3 JB	18 B	6/5
4-Chloroaniline								15
2-Chlorophenol								40/30
1,2-Dichlorobenzene								600/64
1,3-Dichlorobenzene								600/0.5
1,4-Dichlorobenzene								75/0.4 c
Diethylphthalate								5,000
2,4-Dimethylphenol								73
Hexachlorethane								1 c
2-Methylphenol								180
4-Methylphenol								18
2-Methylnaphthalene								12
Naphthalene								20/0.7
Nitrobenzene								0.4
N-Nitro-di-n-propylamine								0.01 c
4-Nitrophenol								60
O-Toluidine								NL
2,2'-oxybis(1-Chloropropane)								NL
Phenol								4,000

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* = HSCA Uniform Risk Based Remediation Standards for groundwater

B = Analyte present in blank.

D = Reported value is result of analysis performed at dilution factor.

E = Reported value exceeded the calibration range of instrument.

J = Analyte present. Reported value is an estimate.

c = carcinogenic

NL = Not Listed

Site Name: Syntech

DE-0173

Sampling Date(s): November 1997

TABLE 2
DATA SUMMARY FORM: SEMIVOLATILES
GROUNDWATER 11/97
ug/L

Sample Number Analyte	MW7	MW10	MW11	MW12	MW13	MW15	MW16	HSCA URS* Dec-99
Aniline				4,400 E / 6,700 D ²⁵⁰	4,700 E / 6,700 D ²⁵⁰			12 c
bis(2-chloroethoxy)ether								
bis(2-ethoxyhexyl)phthalate	3 J	1 JB	37 B	4 JB	40 B	890 BE / 1,800 BD	2 JB	0.01 c 6/5
4-Chloroaniline				45	180 E			15
2-Chlorophenol								40/30
1,2-Dichlorobenzene				3 J	3 J			600/64
1,3-Dichlorobenzene								600/0.5
1,4-Dichlorobenzene								75/0.4 c
Diethylphthalate								5,000
2,4-Dimethylphenol								73
Hexachlorethane								1 c
2-Methylphenol								180
4-Methylphenol								18
2-Methylnaphthalene								12
Napthalene				4 J 44			2	20/0.7 0.4
Nitrobenzene								0.01 c
N-Nitro-di-n-propylamine								60
4-Nitrophenol				240 E	2,300 E /			NL
O-Toluidine					3,700 D ²⁵⁰			
2,2'-oxybis(1-Chloropropane)								NL
Phenol								4,000

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B = Analyte present in blank.

D = Reported value is result of analysis performed at dilution factor.

E = Reported value exceeded the calibration range of instrument.

J = Analyte present. Reported value is an estimate.

c = carcinogenic

NL = Not Listed

Site Name: Syntech

DE-0173

Sampling Date(s): November 1997

TABLE 2
DATA SUMMARY FORM: SEMIVOLATILES
GROUNDWATER 11/97
ug/L

Sample Number Analyte	MW17	MW18	MW20	MW21	MW22	MWP1	MWP2	HSCA URS* Dec-99
Aniline								12 c
bis(2-chloroethoxy)ether								0.01 c
bis(2-ethylhexyl)phthalate	98 BE	3 JB	39 B	1 JB		140 BE / 120 BD	1,300 BE 8,200 BD ¹²⁵	6/5
	100 BD ²							
4-Chloroaniline								15
2-Chlorophenol								40/30
1,2-Dichlorobenzene		3 J				3 J		600/64
1,3-Dichlorobenzene								600/0.5
1,4-Dichlorobenzene								75/0.4 c
Diethylphthalate					1 J	1 J		5,000
2,4-Dimethylphenol								73
Hexachlorethane								1 c
2-Methylphenol								180
4-Methylphenol				1 J				18
2-Methylnaphthalene								12
Napthalene								20/0.7
Nitrobenzene								0.4
N-Nitro-di-n-propylamine								0.01 c
4-Nitrophenol					1 J			60
O-Toluidine								NL
2,2'-oxybis(1-Chloropropane)								NL
Phenol								4,000

Bold = Analyte exceeds the URS.

* = HSCA Uniform Risk Based Remediation Standards for groundwater

B = Analyte present in blank.

D = Reported value is result of analysis performed at dilution factor.

E = Reported value exceeded the calibration range of instrument.

J = Analyte present. Reported value is an estimate.

c = carcinogenic

NL = Not Listed

Site Name: Syntech

DE-0173

Sampling Date(s): November 1997

TABLE 2
DATA SUMMARY FORM: SEMIVOLATILES
GROUNDWATER 11/97
ug/L

Sample Number Analyte	MWP3	PW16						HSCA URS* Dec-99
Aniline								12 c
bis(2-chloroethyl)ether								0.01 c
bis(2-ethylhexyl)phthalate	15 B	1 JB						6/5
4-Chloroaniline								15
2-Chlorophenol								40/30
1,2-Dichlorobenzene								600/64
1,3-Dichlorobenzene								600/0.5
1,4-Dichlorobenzene								75/0.4 c
Diethylphthalate	2 J							5,000
2,4-Dimethylphenol								73
Hexachlorethane								1 c
2-Methylphenol								180
4-Methylphenol								18
2-Methylnaphthalene								12
Naphthalene								20/0.7
Nitrobenzene								0.4
N-Nitro-di-n-propylamine								0.01 c
4-Nitrophenol								60
O-Toluidine								NL
2,2'-oxybis(1-Chloropropane)								NL
Phenol								4,000

Bold = Analyte exceeds the URS.

* = HSCA Uniform Risk Based Remediation Standards for groundwater

B = Analyte present in blank.

D = Reported value is result of analysis performed at dilution factor.

E = Reported value exceeded the calibration range of instrument.

J = Analyte present. Reported value is an estimate.

c = carcinogenic

NL = Not Listed

Table 3: Summary of July 2001 Groundwater Analytical Data - VOCs

Site Name: Syntech
DE-0173
Sampling Date(s): July 2001

TABLE 3
DATA SUMMARY FORM: VOLATILES
GROUNDWATER 7/01
ug/L

Sample Number	MW1	MW7	MW12	MW13	MWP1	MWP2	MWP22	PW16	HSCA URS*
Analyte									Dec-99
Benzene	0.6		35	82				0.5 J	5/0.4 c
Bromoform								3.1	100/8
Carbon tetrachloride		1.4							5/2 c
Chlorobenzene		7.7	3,700	5,000				0.2 J	100/11
Chloroform		0.8			0.5	0.4	0.4		100/0.1 c
Dichlorobromomethane								1.5	0.1
1,1-Dichloroethane								0.2 J	81
1,2-Dichloroethane								0.8	5/0.1
1,2-Dichloroethene								0.2 J	70/61
Ethylbenzene			55	87					700 c
Toluene	24								1,000/750
Xylene (total)			56	64					10,000/1,200

Bold + Analyte exceeds the URS.

* = HSCA Uniform Risk Based Remediation Standards for groundwater

J = Analyte present. Reported value may not be accurate or precise.

B = Analyte present in blank..

c = carcinogenic

NL = Not Listed

Table 4: Summary of July 2001 Groundwater Analytical Data – SVOCs

Site Name: Syntech
DE-0173
Sampling Date(s): July 2001

TABLE 4
DATA SUMMARY FORM: SEMIVOLATILES
GROUNDWATER 7/01
ug/L

Sample Number Analyte	MW4	MW5	MW10	MW12	MW13	MW22	HSCA URS* Dec-99
Aniline				100	980		12 c
bis(2-chloroethyl)ether							0.01 c
bis(2-ethylhexyl)phthalate	2 B	2 B	1 B	3 B		2 B	6/5
4-Chloroaniline				48	55		15
2-Chlorophenol			1 J	6 J			40/30
1,2-Dichlorobenzene				3 J	2 J		600/64
1,3-Dichlorobenzene				1 J			600/0.5
1,4-Dichlorobenzene				7 J	11		75/0.4 c
2,4-Dimethylphenol			5 J				73
Hexachlorethane							1 c
2-Methylphenol							180
4-Methylphenol					26		18
2-Methylnaphthalene							12
Naphthalene				5 J	7 J		20/0.7
N-Nitro-di-n-propylamine							0.01 c
O-Toluidine					280		NL
2,2'-oxybis(1-Chloropropane)							NL
Phenol					76		4,000

Bold + Analyte exceeds the URS.

* = HSCA Uniform Risk Based Remediation Standards for groundwater

J = Analyte present. Reported value may not be accurate or precise.

B = Analyte present in blank..

c = carcinogenic

NL = Not Listed

Table 5: Comparative Analysis of Alternatives for Source Area

Table 5. Comparative Analysis of Alternatives For Source Area

Alternative Number	1	2	3	4
Criterion	No Action	Air Sparging and Vapor Extraction	Fenton Reagent Injection	Application/Injection of IIRC
Overall Protection of Human Health and The Environment	Would not be protective of the human health and the environment.	This alternative aids in removal of VOCs and is, therefore, protective.	This alternative has technical difficulties associated with it and, therefore, is not protective.	This alternative aids in the remediation of contaminants including chlorinated methanes and is, therefore, protective.
Compliance With Applicable Local, State, and Federal Regulations	Not in compliance with state regulations.	Will meet all regulations provided the collected off-gas is treated prior to venting in accordance with all regulations.	Will not meet all regulations since Fenton's reagent is not suitable for source area.	Will meet all regulations.
Short-term Effectiveness and Permanence	No implementation.	Will not subject construction workers to any unacceptable risks. Standard safety practices would address the construction risks.	Will not subject construction workers to any unacceptable risks. Standard safety practices would address the construction risks.	Will not subject construction workers to any unacceptable risks. Standard safety practices would address the other risks.
Long-term Effectiveness and Permanence	Would not be effective and would not meet remedial objectives.	Effective since the contaminants are amenable to air sparging and vapor extraction.	Not effective since Fenton's reagent is not effective with chlorinated methanes that are particularly recalcitrant.	Highly effective since chlorinated methanes are anaerobically dechlorinated and prevented from continued migration.
Reduction in Toxicity, Mobility, and Volume of Contamination	None.	Will reduce the toxicity, mobility, and volume through treatment.	Will not reduce the toxicity, mobility, and volume through treatment.	Will reduce the toxicity, mobility, and volume through treatment.

Implementability/ Technical Practicability	None.	No major implementation difficulties anticipated.	No major implementation difficulties anticipated.	No major implementation difficulties anticipated.
Community Acceptance	Unknown.	Unknown.	Unknown.	Unknown. The technology is comparatively new and has worked effectively on other sites with chlorinated organics.
Remediation Monitoring	No implementation.	Will require continued monitoring of source area contamination.	Will require continued monitoring of source area contamination.	Will require continued monitoring of source area contamination.
Permanence	Contamination levels remain same. Residual risk higher than in other alternatives.	Contamination levels will decrease over time. Some residual risk till contamination is completely eliminated.	Contamination levels will not decrease over time.	Contamination levels will decrease over time. Some residual risk till contamination is completely eliminated.
Restoration Time Frame	No time frame.	3 years	No time frame.	3 years
Cost (See Attached Cost Estimate)	\$0	\$286,000	No costs were estimated since the alternative is not effective.	\$160,000

Table 6: Comparative Analysis of Alternatives for Groundwater

Table 6. Comparative Analysis of Alternatives For Groundwater

Alternative Number	1	2	3	4
Criterion	No Action	Natural Attenuation	Fenton's Reagent Injection	Application/Injection of ORC
Overall Protection of Human Health and The Environment	Would not be protective of the human health and the environment.	Would not reduce the threat to human health and the environment. When combined with a source control remedy, has the potential to be protective.	This alternative aids in groundwater remediation and is, therefore, protective.	This alternative aids in groundwater remediation and is, therefore, protective.
Compliance With Applicable Local, State, and Federal Regulations	Not in compliance with state regulations.	Can potentially meet ARARs when combined with a source control strategy.	Will meet all regulations.	Will meet all regulations.
Short-term Effectiveness and Permanence	No implementation.	No implementation.	Will not subject construction workers to any unacceptable risks. Standard safety practices would address the construction risks.	Will not subject construction workers to any unacceptable risks. Standard safety practices would address the construction risks.
Long-term Effectiveness and Permanence	Would not be effective and would not meet remedial objectives.	Requires periodic monitoring of groundwater. Requires institutional controls such as deed restrictions. Requires a program to verify the progression of natural attenuation.	Effective since groundwater contamination is treated and prevented from off-site migration.	Effective since groundwater contamination is treated and prevented from off-site migration.
Reduction in Toxicity, Mobility, and Volume of Contamination	None.	Possibly some reduction in toxicity, mobility, and volume through on-going processes.	Will reduce toxicity, mobility, and volume through treatment.	Will reduce toxicity, mobility, and volume through treatment.
Implementability/ Technical Practicability	None.	Can be easily implemented.	No major implementation difficulties anticipated.	No major implementation difficulties anticipated.

Table 6. Comparative Analysis of Alternatives For Groundwater

Alternative Number	1	2	3	4
Criterion	No Action	Natural Attenuation	Fenton's Reagent Injection	Application/Injection of ORC
			Large quantity of reagent has to be transported to the site. Any underground utilities in the vicinity of the treatment area will need to be relocated.	Any underground utilities in the vicinity of the treatment area will need to be relocated. The technology is comparatively new and has worked effectively on other sites with chlorinated organics.
Community Acceptance	Unknown.	Unknown.	Unknown.	Unknown.
Remediation Monitoring	No implementation.	Will require continued monitoring of groundwater.	Will require monitoring of groundwater till remediation is complete.	Will require monitoring of groundwater till remediation is complete.
Permanence	Contamination levels remain same. Residual risk higher than in other alternatives.	Contamination levels will decrease over time. Some residual risk till contamination is completely eliminated.	Contamination levels will decrease over time.	Contamination levels will decrease over time. Some residual risk till contamination is completely eliminated.
Restoration Time Frame	No time frame.	10 years	3-years	3-years
Cost (See Attached Cost Estimate)	\$0	\$267,000	\$500,000	\$474,000